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Radtrak® Landauer Radon

Manufacture, Calibration and Detection Limits

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April 2, 2013

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Who is Landauer?

Since 1954 Landauer has provided analytical laboratory services for monitoring Personnel and Environmental exposure to ionizing radiation. Our devices measure exposures to all types of radiations, x ray, beta ray, neutron and radon. We have ISO 17025 accredited laboratories in over 15 countries.

Landauer has provided alpha track radon monitoring services since patenting the Radtrak monitor in 1985.

NVLAP®

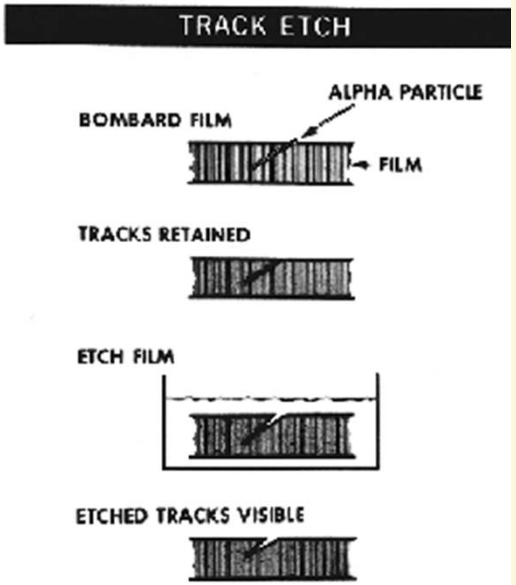
A2LA ACCREDITED

SWEDAC ACKREDITERING 1489 ISO/IEC 17025

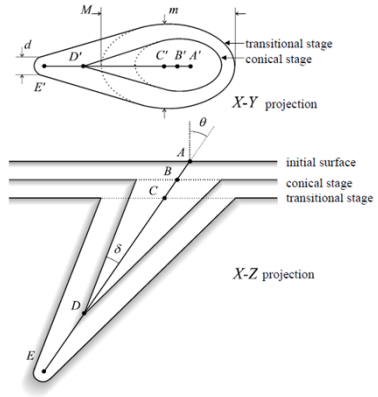
National Radon Proficiency Program NRPP National Environmental Health Association™

DOELAP
Department of Energy Laboratory Accreditation Program

Track Etch Radon Monitors



- Small piece of plastic enclosed within a filter covered diffusion chamber
- Poly-Allyl-Diglycol-Carbonate
- (CR-39)
- Chemically etched, 15.5 h @ 5.5 N NaOH
- Track automatically counted
- Track density related to total radon exposure – pCi-d/L
- Insensitive to humidity, temperature, beta and gamma radiations



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Radon Concentration Calculation

- $Track\ Density = \frac{Total\ Tracks}{Total\ Area\ Read}$ in tracks / mm²

- $Total\ Radon = \frac{(36 * track\ density) + (0.05 * track\ density^2)}{Sensitivity}$

  in pCi-d/L

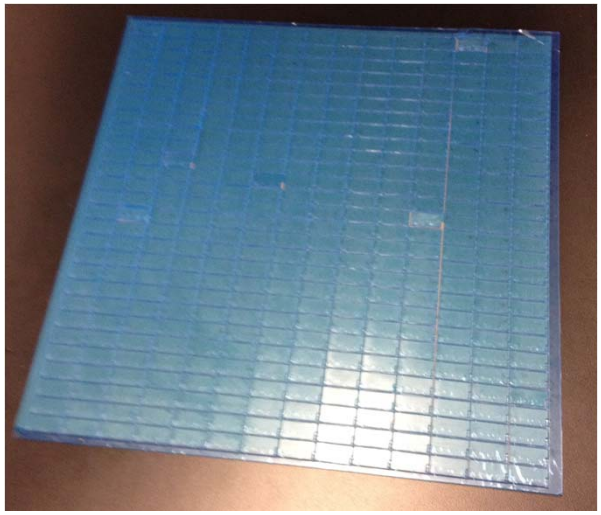
- $Average\ Radon = \frac{Total\ radon}{Exposure\ Days}$ in pCi/L

Quality Control Measures

- All incoming materials used to manufacture Radtrak monitor
- Radon Background and Sensitivity of CR-39 material
- Radon Background growth of manufactured monitor lots
- Blank and Spike monitors for analytical process control
- Proficiency tests

CR39 Material Acceptance

- Sheets of approximately 300 chips
- Laser etched and numbered
- Samples are randomly selected throughout sheet
- Initial background and sensitivity determined for each sheet.
- Sensitivity = measure concentration / delivered concentration
- Acceptable sensitivity within ±10% with a standard deviation of ±10%.
- Sensitivity applied to all radon concentration determinations



Radtrak Material Acceptance

- Validation of Radtrak materials
  - Radon proof of foil pouch
  - Validation of radon concentration performance
    - Radtrak Cap and Cup
    - Radon Progeny Filter

- Continued monitoring of background track density for useful life of monitor
  - Radon and Radon Progeny sealed in bag at time of manufacturing – Po-210 long term
  - Cosmic radiation
  - Material artifacts

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Background Track Density Monitoring Procedures

- Initial track density determined during sensitivity testing
- Background set at time of monitoring manufacturing
- Background validated 7 days after manufacturing.
  - Monitor was not package during period of elevated ambient radon concentration.
  - Static not present at the time of manufacturing
- Background monitored and updated quarterly for a period of at least 4 years. Monitor expiration date set at 2 years post manufacturing.

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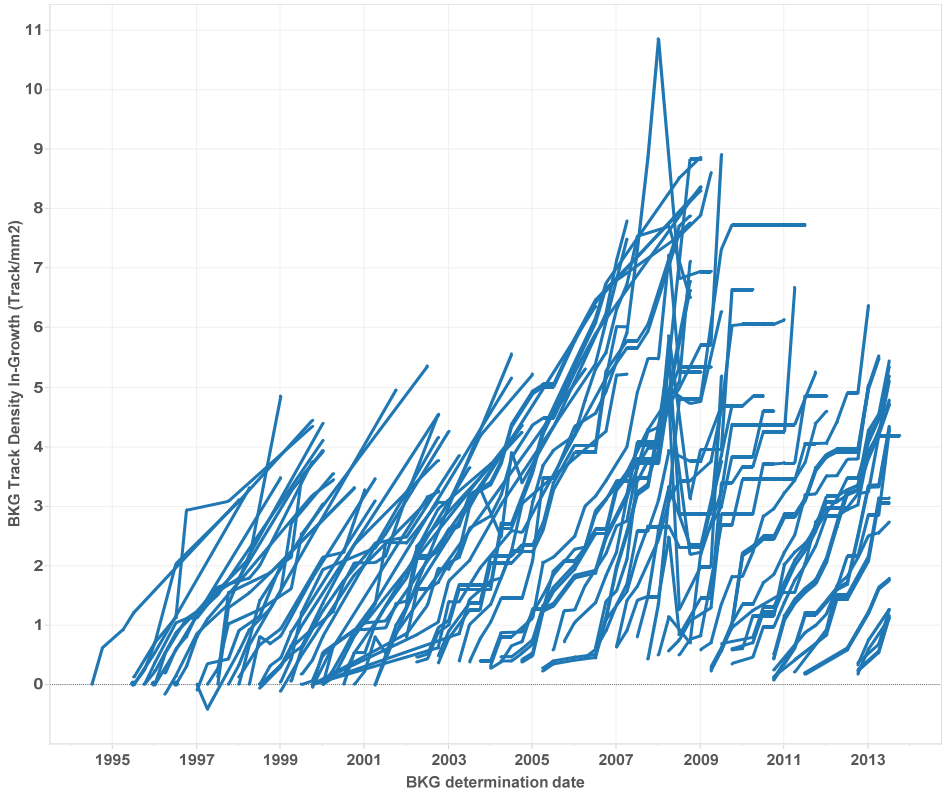
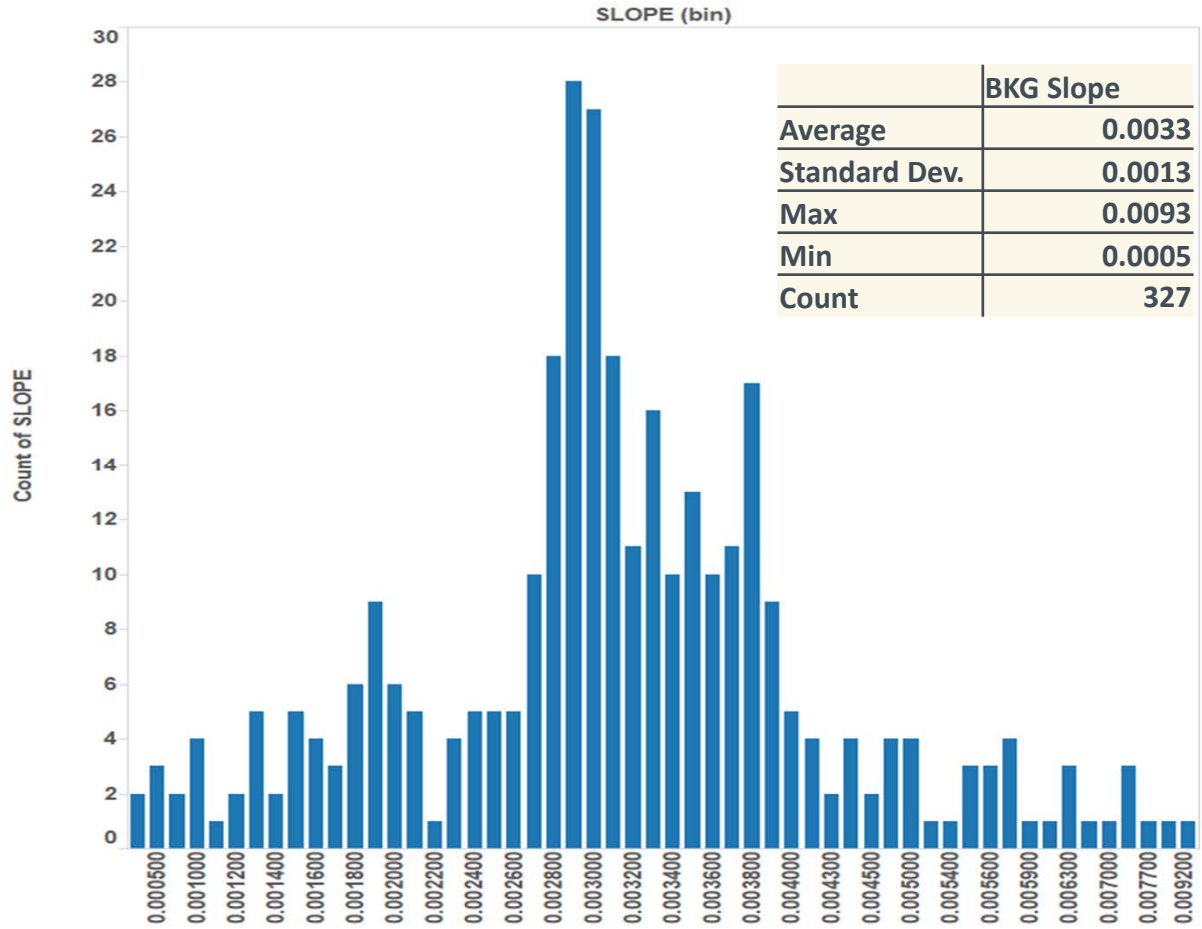
Ingrowth of Material Background Tracks



Rate of Background Growth



	BKG Slope
Average	0.0033
Standard Dev.	0.0013
Max	0.0093
Min	0.0005
Count	327

Last 5 years

Equivalent to 3.5 pCi-d/L for every 30 days of storage

N42.51 *Draft 11-2013* *Low Limit of Detection Equation*

$$LLD_{CT} = [2.71/t_s + 3.29(R_b/t_b + R_b/t_s)^{1/2}]$$

- t_s = Area of sample scanned (mm^2)
- R_b = Blank sample track density ($tracks/mm^2$)
- t_b = Area of blank sample scanned (mm^2)

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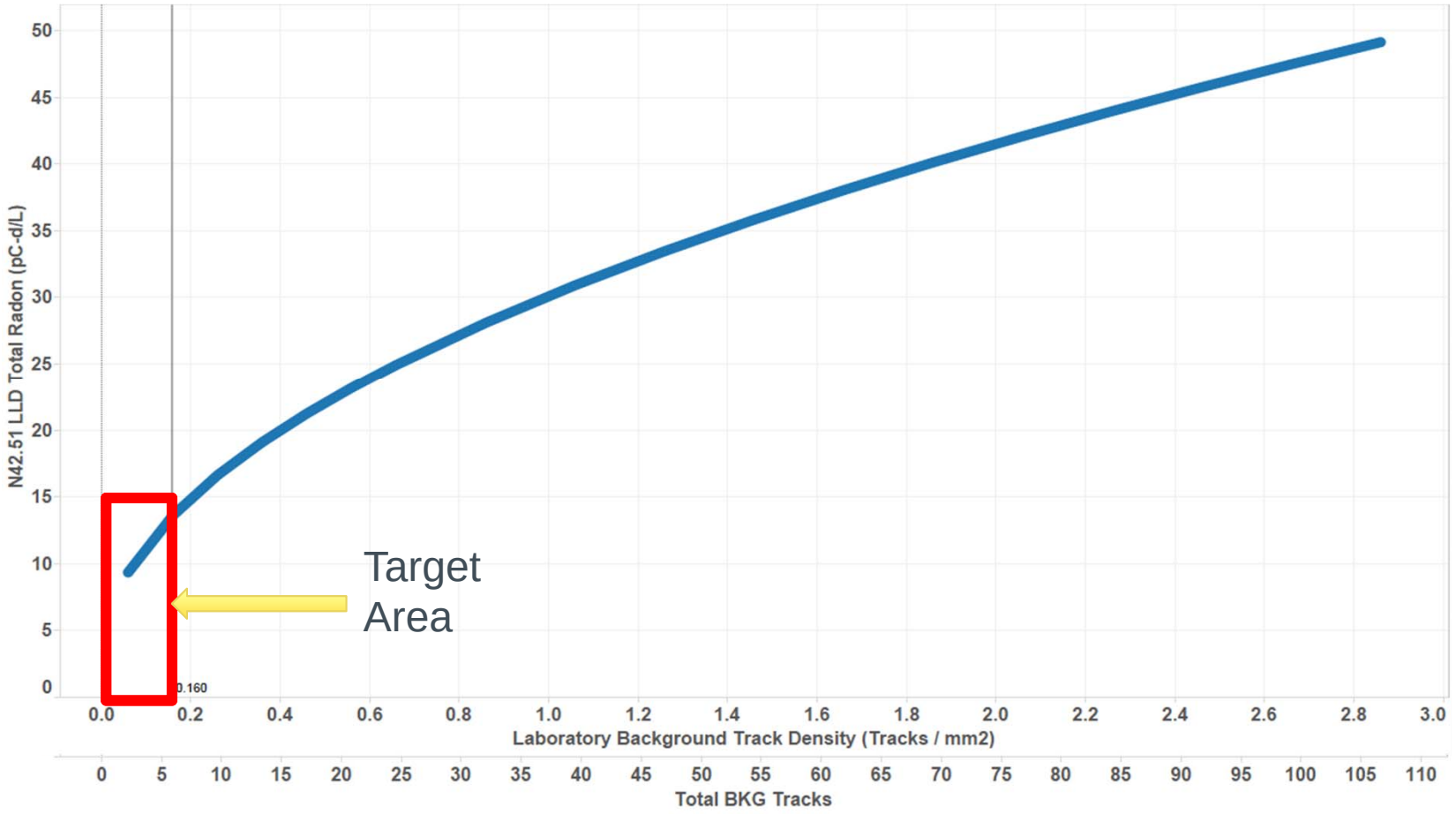
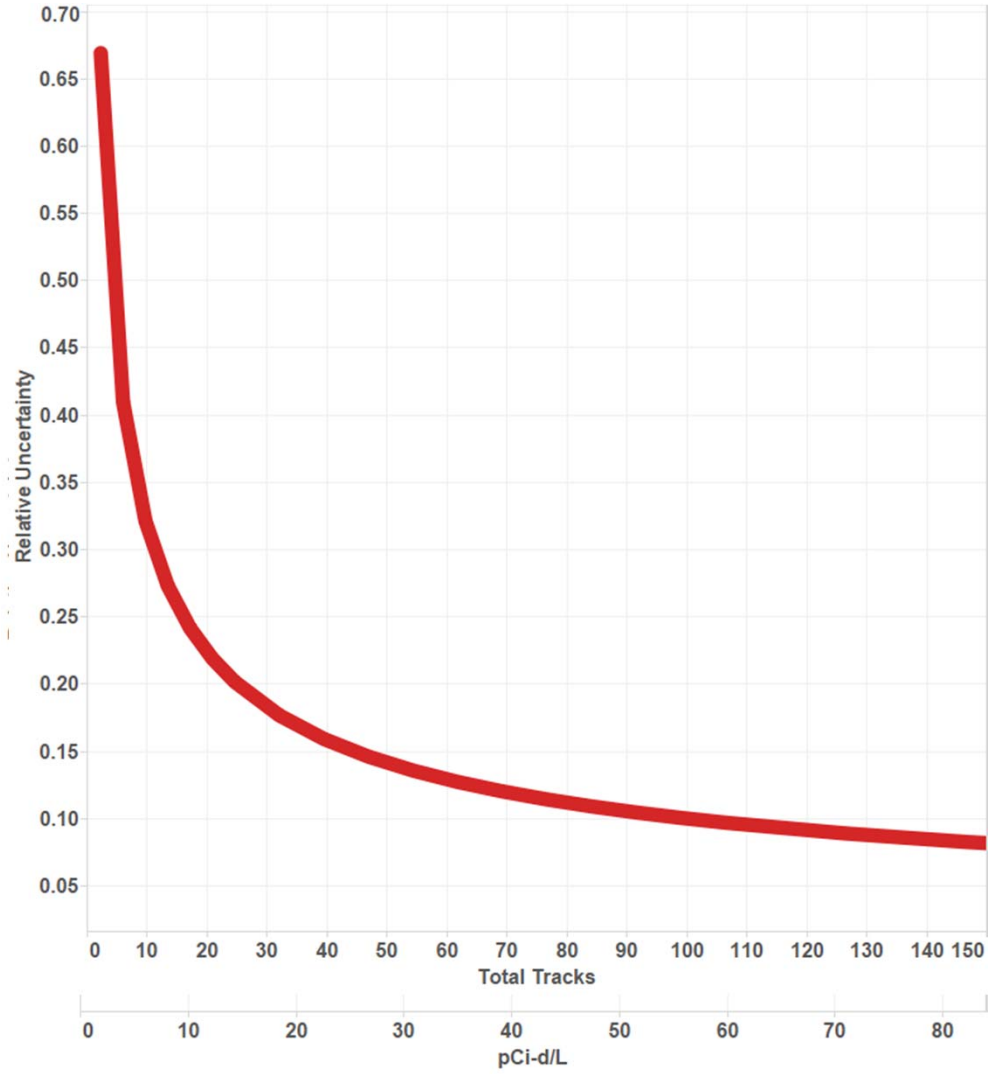
LLD Track Density and Total Tracks



Measurement Uncertainty



- Varies with total number of track counted
- Poisson statistics
- More tracks counted the less measurement uncertainty
- 0.1 pCi/L for 100 days = 10 pCi-d/L ±25%
- 0.1 pCi/L for 180 days = 18 pCi-d/L ±18%

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Ways to Decrease LLD of average radon concentration

- Reduce background track density – “just in time” manufacturing
- Increase the total radon concentration by increased exposure time – 180 days instead of 90 days.
- Increase calibration factor – switch to Rapidos radon monitor

Rapidos Radon Monitor

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- Alpha Track Monitor
- Larger active volume
- Larger read area
- Lower uncertainty due to increase in track count ±10% at 50 pCi-d/L

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Radium -226 Decay Chain